



Results Obtained in the Removal of Bacteria

FROM THE

Sewage of Reading, Pennsylvania,

BY THE

Sewage Purification Process

OF

The Pennsylvania Sanitation Company.

Different Points during the Purification Process	Date of Analysis	Bacteria per Cubic Centimetre		Percentage of Bacteria at different points, as to number applied	Percentage of Bacteria removed
		In applied sewage	In water at each point		
1. Crude sewage.	10-9-'96	27232.8			
2. Sewage through the coke filter.	"	27232.8	19152.4	70.32	29.68
3. After filtration through upper filter beds.	"	27232.8	516.6	1.89	98.11
4. After aeration below upper filter beds.	"	27232.8	126.0	.46	99.54
5. After filtration through lower filter beds.	"	27232.8	22.0	.08	99.92
1. Crude sewage.	10-19-'96	49867.3			
2. Sewage through the coke filter.	"	49867.3	16542.7	33.17	66.83
3. After filtration through upper filter beds.	"	49867.3	232.6	.46	99.54
4. After aeration below upper filter beds.	"	49867.3	81.2	.16	99.84
5. After filtration through lower filter beds.	"	49867.3	.2	.0004	99.9996

Compiled from the Report of Doctors W. M. L. Coplin and H. F. Harris, Professors of Pathology and Bacteriology at the Jefferson Medical College, of Philadelphia. (Dr. Coplin is the Chief Bacteriologist to the State Board of Health of Pennsylvania.) The first analysis, Oct. 9, 1896, was made after the plant had been in operation only ten days. The second analysis was made after twenty days' operation, showing increased efficiency with continued use. Attention is especially called to the remarkable showing evinced by the enormous reduction in the number of bacteria present in the sewage at the second analysis, from nearly fifty thousand to but a small fraction of one to the cubic centimetre.

REPORT.

SUBJECT:—Purification of Sewage as at present in use by the
City of Reading. Also examination of the Reading
City Water.

November 2, 1896.

PENNSYLVANIA SANITATION CO.,

Mr. J. J. Deery, Representative of the Company,

Room 1110 Betz Building, Philadelphia, Penna.

GENTLEMEN:

The following report is respectfully submitted:

October the 8th we forwarded to Mr. H. A. Deery, 519 Chestnut Street, Reading, Penna., seven (7) sterile containers for the shipment of water for bacteriologic and chemic analysis. At noon, October the 9th, we received from Mr. H. A. Deery in person the seven (7) containers filled. Each container was sealed, the seal bearing the inscription, "E. Chamberlain, City Engineer, per Charles H. Gerhard," and all had been collected the morning of their delivery. The examination of the samples was made, or at least begun, immediately. At the time of the examination we had no knowledge as to the points from which the samples had been collected, a later communication from Mr. J. J. Deery, a copy of the items as made by Mr. Gerhard, supplied the additional data as to the source of each sample, as given in the following detailed report. The bacteriologic examination was made by Dr. Coplin and the chemic examination by Dr. Harris.

Sample No. 1—**Untreated Sewage.** Physical examination: Slightly cloudy on agitation, but by subsidence gave a clear, supernatant fluid with a dark, greyish-green sediment. Odor offensive, clearly containing coal-gas.

Sample No. 2—**Sewage after filtration through coke:** Same physical characteristics as No. 1, except that the sediment was less and the odor materially diminished, but still well marked.

Sample No. 3—After filtration through first filter bed.

“ “ 4— “ aeration beyond “ “ “
“ “ 5— “ filtration through second “ “
“ “ 6—Effluent just before entering conduit.
“ “ 7—Water supply at Reading.

Samples 3, 4, 5, 6 and 7 were without sediment, odorless and clear, with the exception of No. 7, which could not be said to be cloudy, although, by comparison, was less clear than 3, 4, 5 or 6.

Samples submitted October the 19th, 1896.

These samples were collected under the same precaution as already described for previous samples. They were sealed and delivered under the same conditions. The numbers appended indicate their source the same as given for previous samples.

Sample No. 1 was greyish-black, almost slate colored; a blackish sediment fell slowly and the supernatant fluid failed to clear completely. The odor was highly offensive and thoroughly impregnated with coal-gas. This sample to the eye gave a most perfect picture of crude sewage in its worst state.

Sample No. 2 contained less suspended matter, and on sedimentation became much clearer, but not absolutely clear. The odor was less marked and very much less offensive.

Samples No. 3, 4 and 5 were clear, colorless and without odor or sediment.

The accompanying tables show the results of the bacteriologic and chemic analysis.

TABLE NO. 1.

Tabulated Report of the Bacteria Present.

Samples for October the 9th, 1896.

No. 1	contains	27232.8	bacteria to the cubic centimetre.
" 2	"	19152.4	" " " "
" 3	"	516.6	" " " "
" 4	"	126.0	" " " "
" 5	"	22.0	" " " "
" 6	"	182.0	" " " "
" 7	"	106.1	" " " "

We have since been informed that the rise in the number of bacteria in No. 6 is accounted for by the fact that the conduit from which the sample was taken had been used for the transmission of crude sewage, and had not been thoroughly cleaned to receive the purified effluent.

TABLE NO. 2.

Tabulated Report of the Bacteria Present.

Samples for October the 19th, 1896.

No. 1	contains	49867.3	bacteria to the cubic centimetre.
" 2	"	16542.7	" " " "
" 3	"	232.6	" " " "
" 4	"	81.2	" " " "
" 5	"	.2	" " " "

TABLES NO. 3 AND 4.

Tabulated Report of the Chemic Examination.

First series of samples dated October the 9th, 1896.

No. of Sample	Reaction	Chlorides parts per 100,000	Phosphates	Total Hardness in parts per 100,000	Oxygen consumed in the moist oxygen process for determining organic matter parts per 100,000	Free Ammonia parts per 100,000	Albuminoid Ammonia parts per 100,000	Amount of nitrogen as nitrates and nitrites parts per 100,000
1	Acid	9.	No trace	15.54	3.947	.34	.14	.429
2	"	6.4	"	15.54	2.187	.27	.09	.650
3	"	6.4	"	16.095	1.125	.022	.02	.673
4	"	6.4	"	16.65	.937	.019	.015	.787
5	"	7.	"	16.65	.812	.01	.025	.984
6	"	6.3	"	16.65	1.062	.05	.032	.756
7	"	.4	"	8.88	.75	.005	.012	.003

Second series of samples dated October the 19th, 1896.

1	Acid	6.5	No trace	16.095	16.000	.590	.730	.420
2	"	6.5	"	16.650	4.000	.370	.060	.305
3	"	6.5	"	16.650	2.000	.055	.025	.910
4	"	6.5	"	17.760	2.000	.065	.040	.951
5	"	6.5	"	17.760	1.800	.010	.055	.972

REMARKS—While the above figures speak for themselves, there is no reason for our not calling your attention to the remarkable reduction in the number of bacteria which the process seems to assure in removing, in the last series for example, over 99.99 per cent. of the bacteria disappear during the purifying process. The chemic study shows the enormous reduction of the free and albuminoid ammonias and the rise of the nitrites and nitrates, thus converting, to a large extent, suspicious compounds into salts of which we feel no anxiety.

Respectfully submitted,

W. M. L. COPLIN, M. D.
H. F. HARRIS, M. D.

SANITARY WATER ANALYSIS—Parts in 100,000.

	APPEARANCE		ODOR		AMMONIA		CHLORINE	NITROGEN		HARDNESS
	Turbidity	Sediment	When Cold	When Hot	Free	Albuminoid		Nitrates	Nitrites	
<p>READING FILTER BED—Area, 12,500 sq. ft., double deck, 21,000,000 gallons sewage daily. Effluent collected from five separate underdrains, by C. W. Page, February 13, 1897, when filter was partly covered with ice and snow. The City sewage of Reading, Pa., is run through a coke filter that requires an average of 120 lbs. of coke per day.</p> <p>Analysis by Ellen H. Richards, Massachusetts Institute of Technology.</p>	None	Slight	Earthy	Faintly	.0480	.0142	5.76	.2400	.0030	32.0
	V. slight	Cons. sand	Distinctly musty and disagreeable	Decidedly musty	.2400	.0200	5.00	0.7500	.0180	5.3
	V. slight	None	Decidedly musty and disagreeable	Decidedly musty	.2800	.0180	4.95	0.4750	.0080	5.6
	7-None 6-V. slight 1-Slight	6-None 4-V. slight 2-Slight 2-Cons.	5-None 5-Dec. musty 2-F. musty 2-Offensive	1-None 9-Dec. musty 2-F. musty 2-Offensive	.2563	.0085	4.78	1.2235	.0057	6.7
	5-None 4-V. slight 3-Slight 2-Distinct	2-None 5-V. slight 7-Slight	4-None 1-V. faint 2-F. musty 4-Dec. musty 1-Disagr. ble 2-Offensive	4-F. musty 6-Dec. musty 1-Unpleasant 3-Offensive	.2145	.0084	4.47	.9098	.0048	5.9
<p>FRAMINGHAM FILTER BED—Area, 16 acres, 400,000 gallons sewage daily.</p>										
<p>East Underdrain, collected January 23, 1895. p. 612.</p>										
<p>East Underdrain, collected February 9, 1895. p. 612.</p>										
<p>East Underdrain, average of 14 examinations made during 1895. p. 612.</p>										
<p>West Underdrain, average of 14 examinations made during 1895. p. 614.</p>										
<p>GARDNER FILTER BED Area, 1½ acres, 250,000 gallons sewage daily. Effluent from underdrain, average of 16 examinations made during 1895. p. 622.</p>	4-Slight 6-Distinct 6-Decided	8-Slight 1-V. slight 7-Cons.	5-Musty and disagreeable 9-Offensive 2-Unpleasant	3-Dec. musty 3-Musty and disagreeable 8-Offensive	.5090	.0552	2.63	.7550	.0119	4.2
<p>MARLBORO FILTER BED—Area, 9½ acres, 500,000 gallons sewage daily. Effluent from underdrain, average of 32 examinations made during 1895. p. 628.</p>	6-V. slight 12-Slight 10-Distinct 4-Decided	6-V. slight 19-Slight 6-Cons. 1-Heavy	3-F. musty 6-Ds. musty 13-Offensive 10-Musty and disagreeable	6-Ds. musty 7-Musty and disagreeable 19-Offensive	.6427	.0299	5.54	.9056	.0120	7.8

*These figures are based upon personal measurement of the effluent in the trunk underdrains. Estimates based upon records at pumping station are about 100,000 gals. higher.

Danvers, Mass., 3-2-97.

NOTE.—The above report upon the admirable action of the Reading filter bed, was made in the interest of the Danvers (Mass.) Lunatic Hospital, of which Dr. Charles W. Page is the Superintendent, and is submitted in comparison with results obtained by the Massachusetts State Board of Health, whose highly creditable work along these lines is so well known. The analyses were made by Mrs. Ellen H. Richards, who has served the Massachusetts Board in the same capacity for some years.

CHARLES W. PAGE.